

I claim:

1. An apparatus for image registration comprising:
- a controller for selecting at least one reference information structure;
  - a controller for selecting at least one sensor model; and
  - a processor for matching image data to said at least one reference information structure using said at least one sensor model.
2. The apparatus of claim 1, wherein at least one of said at least one reference information structure comprises
- an anatomical atlas.
3. The apparatus of claim 2, wherein said anatomical atlas comprises
- a coordinate system.
4. The apparatus of claim 1, wherein at least one of said at least one sensor model comprises
- a model corresponding to a modality of a sensor used to acquire said image data.
5. The apparatus of claim 1, wherein at least one of said at least one sensor model comprises
- a model of the distribution of elements representing features in said image data.
6. The apparatus of claim 1, wherein at least one of said at least one sensor model comprises
- a model of the distribution of elements representing anatomical features in said image data.
7. An apparatus for image registration comprising:
- a controller for selecting at least two images;
  - a controller for selecting at least one sensor model;
  - a controller for selecting at least one distribution model; and

a processor for matching said at least two images to each other using said sensor model and said at least one distribution model.

8. The apparatus of claim 7, further comprising:

a controller for selecting at least one landmark in at least one of the selected images, and wherein said processor further comprises means for matching said selected images using said selected at least one landmark.

9. The apparatus of claim 7, wherein at least one of said at least one sensor model comprises a model corresponding to a modality of a sensor used to acquire image data to be registered.

10. The apparatus of claim 7, wherein at least one of said at least one distribution model comprises:

a model of the distribution of elements representing anatomical features.

11. An apparatus for image registration comprising:

a controller for selecting at least a first image and a second image;

a controller for selecting at least one distribution model corresponding to a segmentation of said first image; and

a processor for matching at least said first image and said second image using said at least one distribution model.

12. The apparatus of claim 11, wherein the distribution model further comprises

a representation of the distribution of elements in an image comprising at least one feature of interest.

13. An apparatus for image registration comprising:

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a controller for selecting at least a first image and a second image;  
a controller for selecting at least two distribution models;  
a controller for selecting a distance measure for measuring a distance between at least two  
of said selected distribution models; and  
a processor for matching at least said first image and said second image using said at least  
one distribution model and said distance measure.

14. A method for image registration comprising:

selecting a registration model;  
selecting a distance measure incorporating the registration model; and  
registering a first image with at least a second image using a registration transform using  
said distance measure.

15. The method of claim 14, wherein the step of selecting a registration model comprises the  
step of:

selecting a registration model corresponding to a sensor modality.

16. The method of claim 14, wherein the step of selecting a registration model comprises the  
step of:

selecting a registration model corresponding to a distribution of image elements  
constituting an image feature.

17. A method for image registration comprising:

selecting at least one landmark in a first image;  
determining at least one normal vector for at least one of said selected at least one  
landmark;

computing at least one gradient vector for a second image; and  
registering said first image and said second image by matching said at least one normal vector corresponding to said first image to said at least one gradient vector for said second image.

18. A method for image registration comprising:

selecting at least one reference information structure;  
selecting at least one sensor model; and  
matching image data to said at least one reference information structure using said at least one sensor model.

19. A method for image registration comprising:

selecting at least two images;  
selecting at least one sensor model;  
selecting at least one distribution model; and  
matching said at least two images to each other using said at least one sensor model and said at least one distribution model.

20. A method for image registration comprising:

selecting at least a first image and a second image;  
selecting at least one distribution model corresponding to a segmentation of said first image; and  
matching at least said first image and said second image using said at least one distribution model.

21. An apparatus for image registration comprising:

means for selecting a registration model;

means for selecting a distance measure incorporating the registration model; and  
means for registering a first image with at least a second image using a registration transform using said distance measure.

22. An apparatus for image registration comprising:

means for selecting at least one landmark in a first image;  
means for determining at least one normal vector for at least one of said selected at least one landmark;  
means for computing at least one gradient vector for a second image; and  
means for registering said first image and said second image by matching said at least one normal vector corresponding to said first image to said at least one gradient vector for said second image.

23. An apparatus for image registration comprising:

means for selecting at least one reference information structure;  
means for selecting at least one sensor model; and  
means for matching image data to said at least one reference information structure using said at least one sensor model.

24. An apparatus for image registration comprising:

means for selecting a first image and a second image;  
means for selecting at least one sensor model;  
means for selecting at least one distribution model; and  
means for matching said first image and said second image using said sensor model and said at least one distribution model.

25. An apparatus for image registration comprising:

means for selecting at least a first image and a second image;

means for selecting at least one distribution model corresponding to a segmentation of said first image; and

means for matching at least said first image and said second image using said at least one distribution model.

26. A method for image registration during a medical procedure comprising:

selecting landmarks on a subject's body with a probe;

computing from an orientation of said probe, corresponding normals for said selected landmarks;

computing normals for an image, wherein said image contains elements corresponding to said selected landmarks on said subject's body; and

registering said image with a coordinate frame corresponding to a position of said subject's body by relating said normals for said selected landmarks to said normals for said image.

27. An apparatus for image registration during a medical procedure comprising:

a probe;

means for computing from an orientation of said probe, normals corresponding to landmarks on a subject's body selected by said probe;

means for computing normals for an image, wherein said image contains elements corresponding to said selected landmarks on said subject's body, and

means for registering said image with a coordinate frame corresponding to a position of said subject's body by relating said normals for said selected landmarks to said normals for said image.

28. A surgical navigation system comprising:

a probe;

means for computing from an orientation of said probe, normals corresponding to landmarks on a subject's body selected by said probe;

means for computing normals for an image, wherein said image contains elements corresponding to said selected landmarks on said subject's body; and

means for registering said image with a coordinate frame corresponding to a position of said subject's body by relating said normals for said selected landmarks to said normals for said image.

29. A surgical navigation system for image registration comprising:

a controller for selecting at least one reference information structure;

a controller for selecting at least one sensor model; and

a processor for matching image data to said at least one reference information structure using said at least one sensor model.

30. A surgical navigation system for image registration comprising:

a controller for selecting at least a first image and a second image;

a controller for selecting at least one distribution model corresponding to a segmentation of said first image; and

a processor for matching at least said first image and said second image using said at least one distribution model.

31. A surgical navigation system for image registration comprising:

selecting a registration model;  
selecting a distance measure incorporating the registration model; and  
registering a first image with at least a second image using a registration transform using said distance measure.

32. An apparatus for image registration comprising:

means for selecting a registration model;  
means for selecting a distance measure incorporating the registration model; and  
means for registering a first image with at least a second image using a registration transform using said distance measure.

33. A computer program product for use in a computer adapted for image registration, the computer program product comprising a computer readable medium for storing computer readable code means, which when executed by the computer, enables the computer to perform image registration, and wherein the computer readable code means includes computer readable instructions for causing the computer to execute a method comprising:

means for selecting a registration model;  
selecting a registration model;  
selecting a distance measure incorporating the registration model; and  
registering a first image with at least a second image using a registration transform using said distance measure.



34. A method for correlating images comprising:

selecting a registration model;

selecting a distance measure incorporating the registration model; and

correlating a first image with at least a second image using a transform using said distance measure.

35. A method for correlating images comprising:

selecting a gaussian registration model comprising at least one of either a sensor model or a distribution model indicating the distribution of image elements constituting at least one anatomic feature of interest;

selecting a Kullback-Liebler distance measure incorporating the registration model; and

correlating a first image with at least a second image using a transform using said distance measure.